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1 Balloon Fabrics. A new method recently tried out for determining the permeability of fabrics to gases, gives promise of success. Pure carbon dioxide is passed over one side of the fabric and hydrogen over the other, the carbon dioxide then being absorbed in sodium hydroxide solution. The hydrogen is measured and its purity checked by combustion. Apparatus has been constructed and tried for measuring the differential heat conductivity of gases, in connection with the work on permeability, and this also offers promise of success.

About 200 fabrics were tested during the past month and 60 have been prepared for exposure tests. A study is being made of the causes of failure in large balloons, of fabrics which will last well in smaller balloons, by exposure of a series of samples under tension. The examination of microsections of balloon fabrics is another new line of work which promises interesting results.

2 Exhaust Gases of Airplane Motors. Gas analyses have been made regularly during the month on exhaust gases obtained by sampling during airplane motor tests. Apparatus is being constructed for observing at any moment the percentage of combustible gases in the exhaust, but important mechanical difficulties in this device are yet to be overcome.

3 Airplane Dopes. A satisfactory method for the production of ethyl lactate, one of the best solvents for dopes, is being sought. A study of dopes made by British formulas, but using American cellulose acetate, is under way. The properties of dopes depend not only upon the solvents and plastics but also to a marked degree upon the method of manufacturing the cellulose acetate. Likewise, the temperature, humidity and other conditions under which a dope is applied influence the character of the film to a marked degree. The work was undertaken for the purpose of defining these important factors.

4 Inks and Adhesives. A considerable amount of testing of inks and adhesives has been carried out recently. It is worthy of note that manufacturers are now making serious attempts to produce ink powders or tablets that possess the permanence of record inks. Formerly such preparations consisted of synthetic dyes. A slight improvement was obtained by the use of soluble Prussian blue. Recently a gallo-tannate of iron ink was received for test. The basic idea of this preparation was not new, but unlike other similar powders or tablets on the market, the writing fluid made from it was clear and remained so for some days. Ordinarily, unless sufficient acid is added, iron gallotannate solutions rapidly become too turbid for use. Soluble inks in dry form will be extremely useful if a satisfactory

product is procured, and both the Post Office Department and the Army are interested in obtaining such a product.

5 Impermeable Linings for Concrete Vessels. The development of a means of obtaining coatings on concrete vessels which shall be impervious to gasoline and other petroleum distillates and also to water is bringing to light many interesting possibilities. In this connection a study is being made of the metal spraying method as well as the application of thin continuous sheet lead linings. The Bureau is in touch with the Standard Oil Company and Guggenheim Brothers in this relation, and important information is being obtained.

6 Ceramic Materials. The two new mixtures for fire bricks to be used on destroyers and cruisers when made into blocks and fired and tested gave very good results. These materials have the advantage of being very refractory, porous, light in weight (bump specific gravity 1.2) and have reduced to an important degree the heat loss through the furnace walls. A white porcelain cement, to be applied to the surface of marine boiler walls, having a dense but refractory character and absorbing less than the ordinary amount of heat by radiation, has been submitted to the Navy and found to be satisfactory.

7 Sensitivity of Infra-Red Signalling. On account of the desirability of comparing the sensitivity of devices for signalling by means of infra-red rays, methods are being developed for carrying out complete tests and the following factors will be determined: (1) the effect of the intensity of the stimulus; (2) the effect of temperature; (3) the spectral radiation sensitivity, using an equal energy spectrum; and (4) the minimum energy perceptible.

8 Leather Sole Substitutes. The Bureau has just reported on its first complete tests of substitutes for leather in the soles of army shoes. These were carried out in cooperation with the Council of National Defense and the Quartermaster General's Office of the War Department. The tests contemplated determination of the wearing qualities of the various composition materials as compared with good oak sole leather and of the different brands as compared with each other in the usage of military service. Samples of widely advertised and extensively used brands selected were placed on regular marching shoes constructed according to specification 1369 and these shoes were allotted to an infantry regiment at Camp Meade. One shoe of each pair was shod with leather and the other with composition, thus affording reliability in the comparison for each pair of shoes. Inspection was made weekly by a representative of the Bureau and when the soles were sufficiently worn or damaged the test was discontinued and the soles removed. Four typical manners of failure were evidenced: (1) cracking of the composition; (2) wearing and breaking off of the composition at the toe and pulling out of the stitches on the inside edge of the sole; (3) leather outwearing the composition materials; (4) composition outwearing the leather.

From an economic and service point of view the leather used in these tests was superior to the composition since the latter by pulling out of the stitches, caused a separation of the outer and middle soles which brought about the failures not commonly occurring in the case of leather, hence the necessity of more frequent repairs. This condition, it will be understood, would not have had the same force in the case of shoes for lighter service than than to which they are subjected in the field service of the army. The type of failure which was of common occurrence in these tests should not appear in civilian or normal wear.

9 Radio Text-book. At the request of the Signal Corps, the Bureau is preparing a general text-book of radio engineering for use in the Radio Schools conducted at a number of universities and colleges in cooperation with the military services; this treatise will be used in connection with the circular on Radio Instruments and Measurements (Circular 74) and publications of the Signal Corps on various special phases of the subject.

10 Photometric Investigations. Photometric work recently carried out has included tests of four special daylight signalling lamps; of three samples of window fabric; of five miniature lamps, with voltage-candlepower curves; hot and cold tests of vapor-proof globes; ten special signalling lamps for the Signal Corps; comparison of two types of acetylene generators; 3 standard jack lamps; and 16 types of flashlights for the Field Medical Supply Depot. In the latter case, measurements of the spherical candlepower of the lamps were made and selection made of the type of flashlight giving the best beam. Efficiency and approximate life tests on the lamps themselves were carried out also.

11 Tests of Secondary Batteries. Tests are being made of small portable storage batteries for the Signal Corps, an investigation particularly urgent and important on account of the need for high efficiency and reliability combined with light weight in the service for which these batteries are required.

12 Effect of Oil on Storage Tanks of Concrete. Supplementing a general field investigation, laboratory tests are in progress to determine the effect of oil on concrete tanks used for oil storage. A number of small tanks of 10 gallons capacity have been fabricated for the storage of oils of varying densities including eleven varieties of mineral oil, two of animal oil and five of vegetable oil, which have been stored since May 20, 1918. Only one ta nk shows sign of penetration by the oil, which in this case is an exceedingly light type having a specific gravity of .797 and a viscosity of 33 at 20°C. In these experiments a 1:2:4 mixture has been used but the work will be extended to other mixtures as well. This is a matter of interest in connection with the shipment of oil in concrete tankers.

13 Other Concrete Investigations. An examination has been made for the Norfolk Navy Yard, of Back River Sand from the vicinity of Norfolk, for use as a fine aggregate in concrete, showing that this sand is a well graded, relatively coarse material suited for the purpose indicated.

Studies have been made to determine, if possible, the comparative utility of various types of concrete mixers availavle on the market. Results indicate that the action of mixing as affected by the design of the seventeen types of concrete and mortar mixers tried does not materially affect the strength of the mortar.

During the month just passed, inspections of cement were made at fifty-three cement mills by inspectors representing the Bureau and a total of 761,701 barrels of inspected cement were shipped, as compared with 54,325 in May, 1917. During the month just passed, 30,600 barrels of cement were rejected, and 41,500 barrels held for check tests because of failure to meet the specification requirements.

An inspection was made of a dry dock at the Brooklyn Navy Yard, the floor of which is deteriorating under the action of sea water and weather.

14 Moulding Sand Investigation. Studies are being undertaken by the metallurgical division on moulding sand problems, with especial reference to (1) reclaiming of "burnt" sand in steel foundries, (2) production of artificial sands and establishment of standards, (3) development of tests of sand quality. The first already gives promise of successful results and may result in the reclaiming of a large proportion of steel foundry sand at a cost of less than 1/4 that of new sand. Demonstration work is being carried on with the kind cooperation of the Washington Navy Yard.

15 Miscellaneous Metallurgical Investigations and Tests. A study is being initiated of the changes in dimensions which occur in steel suitable for gages, dies, etc., subsequent to heat treatment. At the request of the War Industries Board an investigation is being made of a steel producing process that purports to eliminate the blast furnace, to reduce the cost considerably and to save fuel and manganese. The investigation of steel centrifugal castings of the Millspaugh process has been completed and is found to be well worth a trial on a commercial scale with fair promise of success in reducing cost and shortening the process of manufacture of gun liners, eliminating forging and a considerable amount of machine work, and saving steel, fuel and labor. The properties of a newly developed steel (silicon-chrome) for machine gun barrels have been examined. An investigation on the subject of copper pressure plugs for standardizing powders is being taken up, since the subject appears to have hitherto been in a very unsatisfactory condition. 16 samples of steel have been examined within the past month, mostly gun steel of poor physical qualities; tests and examinations were made of cartridge clips and cases; of two types of high explosive shell steel

and semi-steel; a broken motor truck steering post; cast iron scissors for medical kits; broken aeronautic motor crank shaft and valves; 3-inch steel plugs for shrapnel cases; soldered aluminum canteens for testing suitability of the method; German rifle bullets comprising coating of 0.001 inch cupro-nickel on both sides of 0.01 inch steel; preparation of specifications for zinc, copper, tin, antimony, lead and aluminum ingots and sheets; purity of samples of platinum; fusible tin boiler plugs; thermal characteristics of nickel-chromium steel.

Information has been given in correspondence on a great variety of subjects, among which may be mentioned the following: the hardening of copper and brass; case hardening with boron; advice regarding export license for high tin Babbitt to Cuba; lead plating; the coefficient of friction of nickel; electrolytic antimony deposits; transverse fissures in rails; heat treatment of gun forgings; thin armor plate; temperature effects in brasses and bronzes; die castings; iridium content of platinum; the melting point of aluminum; metal identification tags; specifications for army truck bearings; use of cadmium solders in radiators; etching of aluminum; melting ranges of aluminum-copper alloys and acetylene welding of aluminum sheets.

16 Testing Munitions Gages. During the month of June 4884 gages used in the manufacture of munitions of war were tested at the Washington Laboratory of the Bureau of Standards and 395 at the New York City Branch Laboratory. Installation of machinery for the salvaging of gages applying to altered components, for the Ordnance Department of the Army, is being continued at a rapid rate.

Respectfully,

S. W. STRATTON

Director